

CLAIMS

1. A liquid-detecting device comprising:

a base having a first face and a second face opposite to each other, said base being provided with a concavity configured to receive a medium to be detected, said concavity being formed so as to be opened on a side of said first face, said concavity having a bottom configured to be capable of vibrating;

a first electrode formed on a side of said second face of said base, said first electrode having a main portion formed in a size larger than said bottom of said concavity so as to cover an almost overall area corresponding to said bottom of said concavity, said main portion including a notch formed so as to extend inward over a position corresponding to a periphery of said bottom of said concavity;

a piezoelectric layer having a main portion formed in a size smaller than said bottom of said concavity, a whole of said piezoelectric layer being arranged within said area corresponding to said bottom of said concavity, an almost overall said main portion of said piezoelectric layer excluding a part corresponding to said notch of said first electrode being laminated on said first electrode;

an auxiliary electrode formed on a side of said second face of said base so as to extend from an outside of said area corresponding to said bottom of said concavity to an inside of said area corresponding to said bottom of said concavity, a part of said auxiliary electrode being positioned within said notch of said first electrode and supporting a part of said piezoelectric layer from said side of said second face; and

a second electrode having a main portion laminated on said piezoelectric layer and an extension part extending from said main portion of said second electrode so as to be connected to said auxiliary electrode within said area corresponding to said bottom of said concavity.

2. A liquid-detecting device according to Claim 1, wherein said piezoelectric layer has a projection projected from said main portion of said piezoelectric layer within said area

corresponding to said bottom of said concavity, said projection being supported by said auxiliary electrode.

3. A liquid-detecting device according to Claim 1 or 2, wherein said main portion of said second electrode is formed in a size smaller than said main portion of said piezoelectric layer.

4. A liquid-detecting device according to any one of Claims 1 to 3, wherein said main portion of said piezoelectric layer and said main portion of said second electrode are formed in an almost symmetrical form having at least one symmetrical common axis.

5. A liquid-detecting device according to Claim 4, wherein said main portion of said piezoelectric layer and said main portion of said second electrode are all circular and are arranged coaxially with each other.

6. A liquid-detecting device comprising:

a base having a first face and a second face opposite to each other, said base being provided with a concavity configured to receive a medium to be detected, said concavity being formed so as to be opened on a side of said first face, said concavity having a bottom configured to be capable of vibrating;

a first electrode formed in a size larger than said bottom of said concavity on a side of said second face of said base so as to cover an overall area corresponding to said bottom of said concavity;

a piezoelectric layer having a main portion formed in a size smaller than said bottom of said concavity, said main portion of said piezoelectric layer being laminated on said first electrode within said area corresponding to said bottom of said concavity; and

a second electrode having a main portion laminated on said main portion of said piezoelectric layer.

7. A liquid-detecting device according to Claim 6, wherein said piezoelectric layer additionally has an extension part extending from said main portion of said piezoelectric layer up to an outside of said area corresponding to said bottom of said concavity beyond a position corresponding to a periphery of said

concavity.

8. A liquid-detecting device according to Claim 6 or 7, wherein said main portion of said second electrode is formed in a size smaller than said main portion of said piezoelectric layer.

9. A liquid-detecting device according to Claim 7 or 8, wherein said second electrode additionally has an extension part extending from said main portion of said second electrode over said extension part of said piezoelectric layer up to said outside of said area corresponding to said bottom of said concavity.

10. A liquid-detecting device according to any one of Claims 6 to 9, wherein said main portion of said piezoelectric layer and said main portion of said second electrode are formed in an almost symmetrical form having at least one symmetrical common axis.

11. A liquid-detecting device according to Claim 10, wherein said concavity, said main portion of said piezoelectric layer, and said main portion of said second electrode are all circular and are arranged coaxially with each other.

12. A liquid-detecting device according to any one of Claims 9 to 11, further comprising an insulating layer arranged between said extension part of said second electrode and said piezoelectric layer.

13. A liquid-detecting device comprising:

a base having a first face and a second face opposite to each other, said base being provided with a concavity configured to receive a medium to be detected, said concavity being formed so as to be opened on a side of said first face, said concavity having a bottom configured to be capable of vibrating;

a first electrode formed in a size larger than said bottom of said concavity on a side of said second face of said base so as to cover an overall area corresponding to said bottom of said concavity;

a piezoelectric layer having a main portion formed in a size larger than said bottom of said concavity, said main portion of said piezoelectric layer being laminated on said first electrode so as to cover said overall area corresponding to said bottom of

said concavity; and

a second electrode having a main portion formed in a size smaller than said bottom of said concavity, said main portion of said second electrode being laminated on said main portion of said piezoelectric layer within said area corresponding to said bottom of said concavity.

14. A liquid-detecting device according to Claim 13, wherein said main portion of said piezoelectric layer is formed in a size smaller than said main portion of said first electrode.

15. A liquid-detecting device according to Claim 13 or 14, wherein:

said piezoelectric layer additionally has an extension part extending from said main portion of said piezoelectric layer, and

said second electrode additionally has an extension part extending from said main part of said second electrode over said main portion of said piezoelectric layer and said extension part of said piezoelectric layer.

16. A liquid-detecting device according to any one of Claims 13 to 15, wherein the said main portion of said piezoelectric layer and said main portion of said second electrode are formed in an almost symmetrical form having at least one symmetrical common axis.

17. A liquid-detecting device according to Claim 16, wherein said concavity and said main portion of said second electrode are all circular and are arranged coaxially with each other.

18. A liquid-detecting device according to any of Claims 15 to 17, further comprising an insulating layer arranged between said extension part of said second electrode and said piezoelectric layer.

19. A liquid-detecting device comprising:

a base having a first face and a second face opposite to each other, said base being provided with a concavity configured to receive a medium to be detected, said concavity being formed so as to be opened on a side of said first face, said concavity having a bottom configured to be capable of vibrating;

a first electrode having a main portion formed in a size smaller than said bottom of said concavity on a side of said second face of said base, said main portion of said first electrode being arranged inside an area corresponding to said bottom of said concavity;

a piezoelectric layer having a main portion formed in a size smaller than said main portion of said first electrode, said main portion of said piezoelectric layer being laminated on said main portion of said first electrode; and

a second electrode having a main portion formed in a size smaller than said main portion of said piezoelectric layer, said main portion of said second electrode being laminated on said main portion of said piezoelectric layer.

20. A liquid-detecting device according to Claim 19, wherein:

said first electrode additionally has an extension part extending from said main portion of said first electrode up to an outside of said area corresponding to said bottom of said concavity,

said piezoelectric layer additionally has an extension part extending from said main portion of said piezoelectric layer up to said outside of said area corresponding to said bottom of said concavity, and

said second electrode additionally has an extension part extending from said main portion of said second electrode over said main portion of said piezoelectric layer and said extension part of said piezoelectric layer.

21. A liquid-detecting device according to Claim 19 or 20, wherein:

said concavity and said main portion of said first electrode are all circular and are arranged coaxially with each other, and

a diameter of said main portion of said first electrode is equal to or more than 75% of a diameter of said concavity.

22. A liquid-detecting device comprising:

a base having a first face and a second face opposite to each other, said base being provided with a concavity configured

to receive a medium to be detected, said concavity being formed so as to be opened on a side of said first face, said concavity having a bottom configured to be capable of vibrating;

a first electrode formed in a size larger than said bottom of said concavity on a side of said second face of said base so as to cover an overall area corresponding to said bottom of said concavity;

a piezoelectric layer having a main portion formed in a size larger than said bottom of said concavity, said main portion of said piezoelectric layer being laminated on said first electrode so as to cover said overall area corresponding to said bottom of said concavity; and

a second electrode having an annular main portion which has an outer diameter formed in a size smaller than said bottom of said concavity, said annular main portion being laminated on said main portion of said piezoelectric layer within said area corresponding to said bottom of said concavity.

23. A liquid-detecting device according to Claim 22, wherein said main portion of said piezoelectric layer is formed in a size smaller than said main portion of said first electrode.

24. A liquid-detecting device according to Claim 22 or 23, wherein:

said piezoelectric layer additionally has an extension part extending from said main portion of said piezoelectric layer, and

said second electrode additionally has an extension part extending from said main part of said second electrode over said main portion of said piezoelectric layer and said extension part of said piezoelectric layer.

25. A liquid-detecting device according to any of Claims 22 to 24, wherein said main portion of said piezoelectric layer and said main portion of said second electrode are formed in an almost symmetrical form having at least one symmetrical common axis.

26. A liquid-detecting device according to Claim 25, wherein said concavity is circular, and said main portion of said second electrode is in a circular ring shape, and said concavity

and said main portion of said second electrode are arranged coaxially with each other.

27. A liquid-detecting device comprising:

a base having a first face and a second face opposite to each other, said base being provided with a concavity configured to receive a medium to be detected, said concavity being formed so as to be opened on a side of said first face, said concavity having a bottom configured to be capable of vibrating;

a first electrode formed on a side of said second face of said base, said first electrode having a main portion and an extension part, said main portion being formed in a size smaller than said bottom of said concavity and arranged within an area corresponding to said bottom of said concavity, said extension part extending from said main part of said first electrode up to an outside of said area corresponding to said bottom of said concavity;

a piezoelectric layer formed in a size smaller than said bottom of said concavity, said piezoelectric layer being laminated on said first electrode, a whole of said piezoelectric layer being arranged within said area corresponding to said bottom of said concavity;

an auxiliary electrode formed on said side of said second face of said base, said auxiliary electrode extending from said outside of said area corresponding to said bottom of said concavity to an inside of said area corresponding to said bottom of said concavity, a part of said auxiliary electrode supporting a part of said piezoelectric layer from said side of said second face; and

a second electrode having a main portion laminated on said piezoelectric layer and an extension part extending from said main portion of said second electrode so as to be connected to said auxiliary electrode within said area corresponding to said bottom of said concavity.

28. A liquid-detecting device according to Claim 27, wherein said size of said main portion of said first electrode is smaller than said size of said piezoelectric layer, and a size of

said main portion of said second electrode is larger than said size of said main portion of said first electrode.

29. A liquid-detecting device according to Claim 27 or 28, wherein a size of said main portion of said second electrode is smaller than said size of said piezoelectric layer.

30. A liquid-detecting device according to any one of Claims 27 to 29, wherein:

said extension part of said first electrode and said extension part of said second electrode extend mutually in opposite directions along a first straight line passing a center of said concavity, and

said first electrode additionally has a pair of extension parts mutually extending from said main portion of said first electrode in opposite directions along a second straight line which passes said center of said concavity and intersects said first straight line orthogonally.

31. A liquid-detecting device according to Claim 30, wherein said pair of extension parts and said main portion of said first electrode are separated from each other.

32. A liquid-detecting device according to any one of Claims 27 to 31, wherein said main portion of said first electrode, said main portion of said piezoelectric layer, and said main portion of said second electrode are all circular and arranged coaxially with each other.

33. A liquid container comprising:

a container body for storing a liquid; and

a liquid-detecting device as defined in any one of Claims 1 to 32,

wherein said concavity of said liquid-detecting device is exposed in a liquid storage space of said container body.

34. A liquid container according to Claim 33, wherein a liquid for a liquid ejecting apparatus is stored in said container body.

35. A liquid container according to Claim 34, wherein said liquid ejecting apparatus is an ink jet recording apparatus and ink is stored in said container body.